Kindergarten-Red
1st Grade-Orange
2nd Grade-Yellow
3rd Grade-Green
4th Grade-Blue
5th Grade-Purple
6th Grade-Army Green
7th Grade-Pink
8th Grade-Light Blue
Algebra I – Light Purple
Geometry – Rose
Algebra II – Mint Green
Pre-Calculus – Pale Yellow

- Indicates a new Common Core Standard that did not correlate with a SD State Standard

Algebra I

Critical Area 1: Relationships Between Quantities and Reasoning with Equations

Cluster #1

N.Q.1 **Reason quantitatively and use units to solve problems.** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

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N.Q.2 **Reason quantitatively and use units to solve problems.** Define appropriate quantities for the purpose of descriptive modeling.

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N.Q.3 **Reason quantitatively and use units to solve problems.** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

NOTES: ***Working with quantities and the relationships between them provides grounding for work with expressions, equations, and functions.***

Cluster #2

A.SSE.1.a. **Interpret the structure of expressions.** Interpret expressions that represent a quantity in terms of its context. (a) Interpret parts of an expression, such as terms, factors, and coefficients. *

- A.SSE.1.b. **Interpret the structure of expressions.** Interpret expressions that represent a quantity in terms of its context. (b) Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.* *

NOTES: ***Limit to linear expressions and to exponential expressions with integer exponents.***

Cluster #3

A.CED.1 **Create equations that describe numbers or relationships.** Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*

A.CED.2. **Create equations that describe numbers or relationships.** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.3 **Create equations that describe numbers or relationships.** Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

A.CED.4 **Create equations that describe numbers of relationships.** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V=IR to highlight resistance R.*

NOTES: ***Limit A.CED.1 and A.CED.2 to linear and exponential equations, and, in the case of exponential equations, limit to situations requiring evaluation of exponential functions at integer inputs. Limit A.CED.3 to linear equations and inequalities. Limit A.CED.4 to formulas which are linear in the variable of interest.***

Cluster #4

A.REI.1 **Understand solving equations as a process of reasoning and explain the reasoning.** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

NOTES: ***Students should focus on and master A.REI.1 for linear equations and be able to extend and apply their reasoning to other types of equations in future courses. Students will solve exponential equations with logarithms in Algebra II.***

A.REI.3 **Solve equations and inequalities in one variable.** Solve linear equations and inequalities in one variable, including equations with coefficients represented by variables.

Cluster #5

A.REI.3 **Solve equations and inequalities in one variable.** Solve linear equations and inequalities in one variable, including equations with coefficients represented by variables.

NOTES: ***Extend earlier work with solving linear equations to solving linear inequalities in one variable and to solving literal equations that are linear in the variable being solved for. Include simple exponential equatiosn that rely only on application of the laws of exponents, such as*** $5^x = 125$ ***or*** $2^x = \frac{1}{16}$.

Critical Area 2: Linear and Exponential Relationships

Cluster #1

N.RN.1 **Extend the properties of exponents to rational exponents.** Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{\frac{1}{3}}$ *to be the cube root of 5 because we want* $\left(5^{\frac{1}{3}}\right)^3$ *to hold, so* $\left(5^{\frac{1}{3}}\right)^3$ *must equal 5.*

N.RN.2 **Extend the properties of exponents to rational exponents.** Rewrite expressions involving radicals and rational exponents using the properties of exponents.

NOTES: ***In implementing the standards in curriculum, these standards should occur before discussing exponential functions with continuous domains.***

Cluster #2

A.REI.5 **Solve systems of equations.** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A.REI.5 **Solve systems of equations.** Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A.REI.6 **Solve systems of equations.** Solve systems of linear equations exactly and approximately (e.g. with graphs), focusing on pairs of linear equations in two variables.

A.REI.6 **Solve systems of equations.** Solve systems of linear equations exactly and approximately (e.g. with graphs), focusing on pairs of linear equations in two variables.

NOTES: ***Build on student experiences graphing and solving systems of linear equations from middle school to focus on justification of the methods used. Include cases where the two equations describe the same line (yielding infinitely many solutions) and cases where two equations describe parallel lines (yielding no solution); connect to GPE.5 when it is taught in Geometry, which requires students to prove the slope criteria for parallel lines.***

Cluster #3

A.REI.10 **Represent and solve equations and inequalities graphically.** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A.REI.10 **Represent and solve equations and inequalities graphically.** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

A.REI.11 **Represent and solve equations and inequalities graphically.** Explain why the x-coordinates of the points where the graphs of the equations *y=f(x)* and *y=g(x)* intersect are the solutions of the equation *f(x)=g(x)*; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where *f(x)* and/or *g(x)* are linear, polynomial, rational, absolute value, exponential, and logarithmic functions. *

A.REI.12 **Represent and solve equations and inequalities graphically.** Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

NOTES: ***For A.REI.10, focus on linear and exponential equations and be able to adapt and apply that learning to other types of equations in future courses. For A.REI.11, focus on cases where f(x) and g(x) are linear or exponential.***

Cluster #4

F.IF.1 **Understand the concept of a function and use function notation.** Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and *x* is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input *x*. The graph of *f* is the graph of the equation *y=f(x)*.

F.IF.2 **Understand the concept of a function and use function notation.** Use function notation, evaluate function for inputs in their domains, and interpret statements that use function notation in terms of a context.

F.IF.3 **Understand the concept of a function and use function notation.** Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of integers. *For example, the Fibonacci sequence is defined recursively by* $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.

NOTES: ***Students should experience a variety of types of situations modeled by functions. Detailed analysis of any particular class of functions at this stage is not advised. Students should apply these concepts throughout their future mathematics courses. Draw examples from linear and exponential functions. In F.IF.3, draw connection to F.BF.2, which requires students to write arithmetic and geometric sequences. Emphasize arithmetic and geometric sequences as examples of linear and exponential functions.***

Cluster #5

F.IF.4 **Interpret functions that arise in applications in terms of a context.** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* *

F.IF.5 **Interpret functions that arise in applications in terms of a context.** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.* *

F.IF.6 **Interpret functions that arise in applications in terms of a context.** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.*

NOTES: ***For F.IF.4 and 5, focus on linear and exponential functions. For F.IF.6, focus on linear functions and exponential functions whose domain is a subset of the integers. Unit 5 (critical area 5) in this course and the Algebra II course address other types of functions.***

Cluster #6

F.IF.7.a **Analyze functions using different representations.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (a) Graph linear and quadratic functions and show intercepts, maxima, and minima. *

F.IF.7.e **Analyze functions using different representations.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (e) Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. *

F.IF.9 **Analyze functions using different representations.** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

NOTES: ***For F.IF.7a, 7e, and 9 focus on linear and exponential functions. Include comparisons of two functions presented algebraically. For example, compare the growth of two linear functions, or two exponential functions such as*** $y = 3^n$ ***and*** $y = 100^2$**.**

Cluster #7

F.BF.1.a **Build a function that models a relationship between two quantities.** Write a function that describes a relationship between two quantities. (a) Determine an explicit expression, a recursive process, or steps for calculation from context. *

F.BF.1.b **Build a function that models a relationship between two quantities.** Write a function that describes a relationship between two quantities. (b) Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* *

F.BF.2 **Build a function that models a relationship between two quantities.** Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. *

NOTES: ***Limit F.BF.1a, 1b, and 2 to linear and exponential functions. In F.BF.2, connect arithmetic sequences to linear functions and geometric sequences to exponential functions.***

Cluster #8

F.BF.3 **Build new functions from existing functions.** Identify the effect on the graph of replacing *f(x)* by *f(x)+k*, *k f(x)*, *f(kx),* and *f(x+k)* for specific values of *k* (both positive and negative); find the value of *k* given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

NOTES: ***Focus on vertical translations of graphs of linear and exponential functions. Relate the vertical translation of a linear function to its y-intercept. While applying other transformations to a linear graph is appropriate at this level, it may be difficult for students to identify or distinguish between the effects of the other transformations included in this standard.***

Cluster #9

F.LE.1.a **Construct and compare linear, quadratic, and exponential models and solve problems.** Distinguish between situations that can be modeled with linear functions and with exponential functions. (a) Prove that linear functions grow by equal differences over equal intervals; and that exponential functions grow by equal factors over equal intervals.

F.LE.1.b **Construct and compare linear, quadratic, and exponential models and solve problems.** Distinguish between situations that can be modeled with linear functions and with exponential functions. (b) Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

F.LE.1.c **Construct and compare linear, quadratic, and exponential models and solve problems.** Distinguish between situations that can be modeled with linear functions and with exponential functions. (c) Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

F.LE.2 **Construct and compare linear, quadratic, and exponential models and solve problems.** Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).

F.LE.3 **Construct and compare linear, quadratic, and exponential models and solve problems.** Observe using graphs and tables that a quantity increasing exponential eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

NOTES: ***For F.LE.3, limit to comparisons between linear and exponential models. In constructing linear functions in F.LE.2, draw on and consolidate previous work in Grade 8 on finding equations for lines and linear functions (8.EE.6, 8.F.4).***

Cluster #10

F.LE.5 **Interpret expressions for functions in terms of the situation they model.** Interpret parameters in a linear or exponential function in terms of a context.

NOTES: ***Limit exponential functions to those of the form $f(x) = b^x + k$.***

Critical Area 3: Descriptive Statistics

Cluster #1

S.ID.1 **Summarize, represent, and interpret data on a single count or measurement variable.** Represent data with plots on the real number line (dot plots, histograms, and box plots).

- S.ID.2 **Summarize, represent, and interpret data on a single count or measurement variable.** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.

- S.ID.3 **Summarize, represent, and interpret data on a single count or measurement variable.** Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).

NOTES: ***In grades 6-8, students describe center and spread in a data distribution. Here they choose a summary statistic appropriate to the characteristics of the data distribution, such as the shape of the distribution or the existence of extreme data points.***

Cluster #2

- S.ID.5 **Summarize, represent, and interpret data on two categorical and quantitative variables.** Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.

S.ID.6a **Summarize, represent, and interpret data on two categorical and quantitative variables.** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (a) Fit a function to the data; use functions fitted to data to solve problems in the context of the data. *Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.*

- S.ID.6b **Summarize, represent, and interpret data on two categorical and quantitative variables.** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (b) Informally assess the fit of a function by plotting and analyzing residuals.

S.ID.6c **Summarize, represent, and interpret data on two categorical and quantitative variables.** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (c) Fit a linear function for a scatter plot that suggests a linear association.

S.ID.6c **Summarize, represent, and interpret data on two categorical and quantitative variables.** Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (c) Fit a linear function for a scatter plot that suggests a linear association.

NOTES: ***Students take a more sophisticated look at using a linear function to model the relationship between two numerical variables. In addition to fitting a line to data, students assess how well the model fits by analyzing residuals. S.ID.6b should be focused on linear models, but may be used to preview quadratic functions for critical area 5.***

Cluster #3

S.ID.7 **Interpret linear models.** Interpret the slope (rate of change) and intercept (constant term) of a linear model in the context of the data.

S.ID.7 **Interpret linear models.** Interpret the slope (rate of change) and intercept (constant term) of a linear model in the context of the data.

- S.ID.8 **Interpret linear models.** Compute (using technology) and interpret the correlation coefficient of a linear fit.

- S.ID.9 **Interpret linear models.** Distinguish between correlation and causation.

NOTES: ***Build on students' work with linear relationships in eighth grade and introduce the correlation coefficient. The focus here is on the computation and interpretation of the correlation coefficient as a measure of how well the data fit the relationship. The important distinction between a statistical relationship and a cause-and-effect relationship arises in S.ID.9.***

Critical Area 4: Expressions and Equations

Cluster #1

A.SSE.1a **Interpret the structure of expressions.** Interpret expressions that represent a quantity in terms of its context. (a) Interpret parts of an expression, such as terms, factors, and coefficients.*

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A.SSE.1b **Interpret the structure of expressions.** Interpret expressions that represent a quantity in terms of its context. (b) Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.**

A.SSE.1b **Interpret the structure of expressions.** Interpret expressions that represent a quantity in terms of its context. (b) Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.**

- A.SSE.2 **Interpret the structure of expressions.** Use the structure of an expression to identify ways to rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2+y^2)$.**

NOTES: ***Focus on quadratic and exponential expressions. For A.SSE.1b, exponents are extended from the integer exponents found in Unit 1 to rational exponents focusing on those that represent square or cube roots.***

Cluster #2

A.SSE.3a **Write expressions in equivalent forms to solve problems.** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (a) Factor a quadratic expression to reveal the zeros of the function it defines. *

- A.SSE.3b **Write expressions in equivalent forms to solve problems.** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (b) Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.*

- A.SSE.3c **Write expressions in equivalent forms to solve problems.** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. (c) Use the properties of exponents to transform expressions for exponential functions. *For*

example, the expression 1.15^t can be rewritten as $(1.15^{\frac{1}{12}})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%. **

NOTES: ***It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, development of skill in factoring and completing the square goes hand-in-hand with understanding what different forms of a quadratic expression reveal.***

Cluster #3

- A.APR.1 **Perform arithmetic operations on polynomials.** Understand that polynomials forma system analogous to the integers, namely they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

NOTES: ***Focus on polynomial expressions that simplify to forms that are linear or quadratic in a positive integer power of x.***

Cluster #4

A.CED.1 **Create equations that describe numbers or relationships.** Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*.

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A.CED.2 **Create equations that describe numbers or relationships.** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A.CED.4 **Create equations that describe numbers or relationships.** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V=IR to highlight resistance R*.

A.CED.4 **Create equations that describe numbers or relationships.** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V=IR to highlight resistance R*.

NOTES: ***Extend work on linear and exponential equations from Critical Area 1 to quadratic equations. Extend A.CED.4 to formulas involving squared variables.***

Cluster #5

A.REI.4a **Solve equations and inequalities in one variable.** Solve quadratic equations in one variable. (a) Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x-p)^2=q$ that has the same solutions. Derive the quadratic formula from this form.

A.REI.4b **Solve equations and inequalities in one variable.** Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring as appropriate to the initial form of the equation. Recognize when the quadratic formula give complex solutions and write them as $a \pm bi$ for real numbers a and b.

A.REI.4b **Solve equations and inequalities in one variable.** Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring as appropriate to the initial form of the equation. Recognize when the quadratic formula give complex solutions and write them as $a \pm bi$ for real numbers a and b.

NOTES: ***Students should learn of the existence of the complex number system, but will not solve quadratics with complex solutions until Algebra II.***

Cluster #6

- A.REI.7 **Solve systems of equations.** Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.*

NOTES: ***Include systems consisting of one linear and one quadratic equation. Include systems that lead to work with fractions. For example, finding the intersections between $x^2 + y^2 = 1$ and $y = \frac{(x+1)}{2}$ leads to the point (3/5, 4/5) on the unit circle, corresponding to the Pythagorean triple $3^2+4^2=5^2$.***

Critical Area 5: Quadratic Functions and Modeling

Cluster #1

N.RN.3 **Use properties of rational and irrational numbers.** Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

NOTES: ***Connect N.RN.3 to physical situations, e.g., finding the perimeter of a square of area 2.***

Cluster #2

F.IF.4 **Interpret functions that arise in applications in terms of a context.** For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.

*Key features include: intercepts; intervals where the functions is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. **

F.IF.5 **Interpret functions that arise in applications in terms of a context.** Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function. **

F.IF.6 **Interpret functions that arise in applications in terms of a context.** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. *

NOTES: ***Focus on quadratic functions; compare with linear and exponential functions studied in Critical Area 2.***

Cluster #3

F.IF.7a **Analyze functions using different representations.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (a) Graph linear and quadratic functions and show intercepts, maxima, and minima.*

F.IF.7b **Analyze functions using different representations.** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. (b) Graph square root, cube root and piecewise-defined functions, including step functions and absolute value functions.*

F.IF.8a **Analyze functions using different representations.** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (a) Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

F.IF.8b **Analyze functions using different representations.** Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. (b) Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, *and classify them as representing exponential growth or decay.*

F.IF.9 **Analyze functions using different representations.** Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which as the larger maximum.*

NOTES: ***For F.IF.7b, compare and contrast absolute value, step and piecewise-defined functions with linear, quadratic, and exponential functions. Highlight issues of domain, range, and usefulness when examining piecewise-defined functions. Note that this unit, and in particular in F.IF.8b, extends the work begun in Critical Area 2 on exponential functions with integer exponents. For F.IF.9, focus on expanding the types of functions considered to include, linear, exponential, and***

quadratic. Extend work with quadratics to include the relationship between coefficients and roots, and that once roots are knows, a quadratic equation can be factored.

Cluster #4

F.BF.1a **Build a function that models a relationship between two quantities.** Write a function that describes a relationship between two quantities. (a) Determine an explicit expression, a recursive process, or steps for calculation from a context. *

F.BF.1b **Build a function that models a relationship between two quantities.** Write a function that describes a relationship between two quantities. (b) Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.**

NOTES: ***Focus on situations that exhibit a quadratic relationship.***

Cluster #5

F.BF.3 **Build new functions from existing functions.** Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects of the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*

F.BF.4a **Build new functions from existing functions.** Find inverse functions. (a) Sole an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example,* $f(x) = 2x^3$ *or* $f(x) = \frac{x+1}{x-1}$ *for* $x \neq 1$.

NOTES: ***For F.BF.3, focus on quadratic functions, and consider including absolute value functions. For F.BF.4a, focus on linear functions but consider simple situations where the domain of the function must be restricted in order for the inverse to exist, such as $f(x) = x^2$, $x>0$.***

Cluster #6

F.LE.3 **Construct and compare linear, quadratic, and exponential models and solve problems.** Observe using graphs and tables that a quantity increasing exponential eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

NOTES: ***Compare linear and exponential growth to quadratic growth.***